REMARKS

Applicant has carefully considered the Examiner's Office Action and has amended the claims to define the invention in clearer form and to distinguish patentably from the prior art.

Applicant has also amended the specification to provide for the required section headings, and to avoid reference to specific claim numbers.

In amending the claims, applicant has replaced claims 1-10 which were originally filed in the application, with the newly submitted claims 16-26.

These new claims 16-26 include the subject matter and limitations that are not to be found in the prior art.

In considering applicant's invention in relation to the prior art, applicant notes that the reference patent to Berchem (4,532,686) is concerned with only the bottom of a piston. This is in contrast to applicant's invention which concerns the entire piston and not only the bottom of it as in this reference patent.

Thus, the reference patent to Berchem discloses a method for fabricating a piston bottom for internal-combustion engines in which a blank that is saucer-shaped is forged from a refractory steel, and the saucer-shaped blank is then converted into a cup shape by further forging. The cup is provided with a planar rim that is transformed into a cylindrical shoulder. An annular bulge of the blank is formed into an annular boss for connecting the piston bottom of the cylindrical piston body. The blank has a convex shape projecting on one side of the blank opposite to that formed with the bulge. Thereafter, the cup is subjected to a heat treatment.

Unlike the reference patent to Berchem (4,532,686) applicant provides a method for manufacturing piston for internal-combustion engines, in which a blank which is intended to comprise a piston, is at first forged along a prescribed axis,

and specific contours are shaped on the forged blank to form a preliminarily shaped piston.

In at least one subsequent manufacturing step, the preliminarily-shaped piston is forged along at least one other axis for creating additional contours.

According to applicant's invention and unlike the reference patent to Berchem, the piston is formed by two separate forging steps. Each of these steps provides a different contour along a different axis.

The reference patent to Berchem does not at all disclose the manufacture of an entire piston, not just a piston bottom, in which two separate contours are fabricated by two separate forging steps, and that these separate contours are shaped along different axes.

There is no hint, whatsoever, in this reference patent to Berchem that forging takes place at different axes with the formation of separate contours.

It is through applicant's invention that a more efficient fabrication process is realized, and that an improved product is obtained therefrom.

It is submitted that applicant provides for a new and marked improvement over the prior art.

Since the claims in the application define clearly the differences between applicant's invention and the prior art, it is believed that the claims should be found allowable.

Applicant has carefully studied the remaining references which were cited by the Examiner for being of interest but not applied in the case. After detailed analysis of these additional references, applicant has concluded that they are entirely unrelated to applicant's invention, and they do not anticipate the novel features of applicant's arrangement.

The Examiner's attention is respectfully directed to the Court decision in the case of In re Bisley (94 U.S.P.Q. 80, 86) in which the Court ruled that patentability is gauged not only by

Cyanamid Company (227 U.S.P.Q. 293), the Court decided that the issue of obviousness is determined entirely with reference to a hypothetical person having ordinary skill in the art. It is only that hypothetical person who is presumed to be aware of all the pertinent prior art. The actual inventor's skill is irrelevant to the inquiry, and this is for a very important reason. The statutory emphasis is on a person of ordinary skill. Inventor's, as a class, according to the concepts underlying the constitution and the statutes that have created the patent system, possess something that sets them apart from the workers of ordinary skill, and one should not go about determining obviousness under 35 U.S.C. 103 by inquiring into what patentees (i.e., inventors) would have known or would likely have done, faced with the revelation of references. A person of ordinary skill in the art is also presumed to be one who thinks along the line of conventional wisdom in the art and is not one who undertakes to innovate, whether by patient, and often expensive systematic research or by extraordinary insight; it makes no difference which.

With respect to combining references as the Examiner has done, the Court ruled in the case of Uniroyal Inc. versus Rudkin-Wiley Corporation (5 U.S.P.Q.2d 1434), that when prior art references require a selective combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gleaned from the invention itself. Something in the prior art as a whole must suggest the desirability, and thus the obviousness of making the combination.

The preceding decision is reinforced by In re Dow Chemical Company (5 U.S.P.Q.2d 1529), in which it was decided that most technological advance is the fruit of methodical persistent investigation, as is recognized in 35 U.S.C. §103. The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this process should be carried out and would have

reasonable likelihood of success, viewed in the light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure.

In Panduit Corporation v. Burndy Corporation (180 U.S.P.Q. 498), the District Court ruled that inquiry into patentability must be directed towards subject matter as a whole and not to elements of combination and their individual novelty; combination which results in a more facile, economical, or efficient unit, or which provides results unachieved by prior art structures, cannot be anticipated piecemeal by showing that elements are individually old.

Finally, in the case of Meng and Driessen (181 U.S.P.Q. 94), the Court ruled that progress in crowded arts, usually made in small increments, is as important as it is in arts at the pioneer stage; constitution envisages and seeks progress in useful "arts," not just in those more esoteric or scientific.

In view of the amendments to the specification and the claims, and in view of the preceding remarks, it is respectfully requested that the claims in the application be allowed and the case be passed to issue.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D. C. 20231, on 8-16-02

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VERSION WITH MARKINGS TO SHOW THE CHANGES THAT HAVE BEEN MADE

METHOD OF MANUFACTURING PISTONS AND COMPONENTS THEREOF, AND FORGING TOOL ← Forging Tool

BACKGROUND OF THE INVENTION

The present invention concerns a method of manufacturing pistons and components thereof, piston heads for example, especially intended for internal-combustion engines.

German A 3 801 847 discloses a method of manufacturing pistons for internal-combustion engines, each piston being provided with at least one metal reinforcement. The reinforcement, of a material with open pores, is heated and introduced into a heated die. A prescribed amount of aluminum or aluminum alloy is injected into the die. A plunger is introduced into the die, compressing the cooling melt. The compressed melt flows around the reinforcement and fills both the piston mold and the reinforcement's pores. Once the melt has hardened, the piston is removed from the die along with the reinforcement and machine finished.

A piston especially intended for internal-combustion engines is known from German A 19 935 410. This piston features a shaft with a bore for a bolt and an adjacent annular field. Webs extend from the bore toward the annular field and/or toward the end of the shaft remote from the field. Pistons of this type are preferably cast.

German A 3 222 582 describes a method of manufacturing a base for a multiple-component piston, especially intended for large diesel engines. The center of the base is domed and surrounded by a shoulder and has an interior hub. The shoulder accommodates piston rings and rests against a separate piston shaft, onto which the hub can be screwed and/or welded. In this method a bowl with an area that matches the shape of the piston's center and has a surrounding collar is in an initial shaping step forged from a heat-resistant steel. The shoulder and the hub are then in a subsequent shaping step forged out of the collar. This approach, which involves forging axially in terms of the piston's base, however, allows only contours with prescribed wall thicknesses, especially radial wall thicknesses, and the product is heavy and requires a lot of material.

The object of the present invention is a method of manufacturing pistons and components thereof, piston heads for example, whereby the easily worn-down aluminum skirts are eliminated, less material is required, and the pistons or components will be simple to manufacture with ideal wall thicknesses. Another object of the present invention is a forging tool that can be employed to easily manufacture such pistons or components of even complex designs.

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SUMMARY OF THE INVENTION

The object of the present invention is a method of manufacturing pistons and components thereof, piston heads for example, whereby the easily worn-down aluminum skirts are eliminated, less material is required, and the pistons or components will be simple to manufacture with ideal wall thicknesses. Another object of the present invention is a forging tool that can be employed to easily manufacture such pistons or components of even complex designs.

This object is attained in accordance with the present invention in a method of manufacturing pistons and components thereof, piston heads for example, especially intended for internal-combustion engines, wherein in an initial manufacturing stage a blank that will eventually constitute the piston or piston component is preliminarily forged along a prescribed axis, shaping appropriate contours, and wherein in at least one subsequent manufacturing step the preliminarily shaped piston is finally forged along at least one other axis, creating additional contours.

Advantageous further embodiments of the method in accordance with the present invention are addressed in the associated subsidiary claims herein.

The same object is also attained in accordance with the present invention in a forging tool comprising various tool parts in the vicinity of the upper and lower die halves, whereby these tool parts can be advanced within planes defined by axes toward a blank for the purpose of preliminarily and finally shaping pistons and components thereof and whereby tool parts of at least one die half are employed for preliminary forging and tool parts of at least one die half are employed for final forging.

Advantageous further embodiments of the forging tool in accordance with the present invention are addressed in the relevant subsidiary claims herein.

In a departure from the method of manufacture described in German A 3 801 847, accordingly, a steel blank, optionally a rod, that has been produced by multiple-dimensional (multiple-axis) forging in one and the same forging tool can be employed in accordance with the present invention. Aluminum skirts like those employed in the prior art are [illegible] mutually perpendicular. When the shape is more complex, however, the blank could conceivably also be forged over at least one other plane at an angle to the aforesaid two axes.

This approach to the manufacture of a multiple-axis piston or component thereof by forging solves, as hereintofore mentioned, the problem of premature wear on the part of the aluminum skirt typical of conventional configurations in that the piston's or component's positioning skirt is steel and integrated into the overall product. German A 322 582 in no way intimates such a procedure. Furthermore, multiple-axis

forging of a blank, optionally a rod, can also produce filigreed contours, which has been possible heretofore only by casting, while consuming very little material.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be specified with reference to the accompanying drawing, wherein

Figure 1 is a sketch illustrating the principle involved in manufacturing piston heads,

Figure 2 is a sketch illustrating a forging tool in accordance with the present invention in principle,

and

Figure 3 illustrates a piston head forged in accordance with the method illustrated in Figure 1 in the forging tool illustrated in Figure 2.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows the steps involved in manufacturing a piston head. A bar-shaped steel blank 1 is heated by induction for example and upset in a die in axis 1'. The die can be preliminarily heated if necessary. A cavity 2 is shaped out of the blank in the same die and in the same direction, and a

Claims

16. A method of manufacturing pistons and components for pistons thereof, piston heads for example, especially intended for internal-combustion engines, comprising the steps of: (A) manufacturing initially a blank (1) that will eventually constitute a piston or piston component by preliminarily forging along a prescribed axis, and shaping appropriate specific contours (1), and (B) at least one subsequent manufacturing step of forging the preliminarily-shaped piston (7) is finally forged along at least one other axis (1") for creating additional contours (2).

17. A method as defined in Claim 16, wherein said characterized in that the initial manufacturing step (A) comprises preliminarily shaping the said blank along an axis (1') that constitutes its a longitudinal axis of said blank.

18. A method as defined in Claim 16, wherein said blank is 1 or 2, characterized in that in the initial manufacturing step (A) a rod-like and optionally cylindrical blank, (1) is upset and provided with a skirt (2) upsetting the blank to form and a cavity, (2), whereby said contours (3-6) are being shaped onto the said skirt along a longitudinal axis of said skirt (1') in vicinities of inner and outer circumferences (3) and of upper and lower faces of said skirt.

INSERTS FOR CLAIM 16 ABOVE

(1) on the forged blank to form a preliminarily-shaped piston;

(2) said piston or piston component being formed by two separate forging steps, each of said steps having a different contour along a different apis.

19. Method as defined in claim 16, wherein said additional one of Claims 1 through 3, characterized in that in the subsequent manufacturing step (B) further contours ~~(6)~~ are shaped onto the preliminarily-shaped piston ~~(7)~~, along said other another axis ~~(A')~~ by forging at approximately 90° to said the first prescribed axis ~~(A)~~, especially the said first prescribed axis being a longitudinal axis.

20. Method as defined in claim 16, wherein the one of Claims 1 through 4, characterized in that initial manufacturing step (A) along the first prescribed axis and the subsequent manufacturing step (B) along the second other axis are carried out in the same forging tool ~~(10)~~ into which said the blank ~~(1)~~ can be optionally heated before it is inserted insertion.

21. Method as defined in claim 16, wherein said one of Claims 1 through 5, characterized in that during the subsequent manufacturing step (B) the wall thickness of the preliminarily shaped piston ~~(7)~~ has a reducable wall thickness ~~can be~~ decreased, accompanied by the creation of and reinforcements during ~~(22)~~ the subsequent manufacturing step (B).

22. Method as defined in claim 16, including the step of shaping one of Claims 1 through 6, characterized in that during one of the manufacturing steps (A & B) an integrated skirt, ~~(22)~~ can be shaped onto the preliminarily shaped piston, ~~(7)~~ such that the said skirt ~~will be~~ being accommodated within a circumference of said the skirt, ~~(sic)~~ circumference (21) during the subsequent manufacturing step (B).

23, 8. A method as in one of Claims 1 through 7, characterized in that a steel blank (1) is employed.

24, 9. A method as in one of Claims 1 through 8, characterized ~~in that the~~ piston ~~(2)~~ can optionally be reformed within another plane in still another manufacturing step.

25, 10. A method as in one of Claims 1 through 9, characterized in that, especially in the manufacture of piston heads (7), excess material ~~(8)~~ is removed and/or recesses (9) created, especially by punching, during at least one of the manufacturing steps (A & B).

11. Forging tool with in the vicinity of an upper die half (11) and of a lower die half (12) several parts (13, 14, 15, 16, & 17) that can be displaced toward a blank (1) over planes defined by axes (1' & 1"), preliminarily and finally shaping a piston or a component thereof, a piston head for example, whereby the parts in at least one of the die halves (11 or 12) can be employed for the preliminary forging and the parts (16) in at least one lower die half (12) can be employed for the final forging.

12. Forging tool as in Claim 11, characterized in that the parts (13-15) in the upper die half (11) can be employed